REMARKS

Disposition of Claims

Claims 1, 2, 8-20 are currently pending in this application. Claims 12, 16 and 18 are currently amended solely for clarity, and thus for reasons unrelated to patentability. Support for the amended claims can be found throughout the specification, for example in the original claims. No new matter has been added.

I. Claim Objections

The Examiner objected to Claim 18, citing a typographical error. As suggested by the Examiner, "allowys" has been amended to "alloys".

II. Claim Rejections (35 U.S.C. § 112)

The Examiner rejected Claims 12-14 and 16 under 35 USC 112, second paragraph, as being indefinite. As suggested by the Examiner, Claims 12 and 16 have been amended from "the resultant molten metal" to "the molten metal".

III. Art Rejections (35 U.S.C. § 103)

(A) The present invention

The present invention relates to a production method for a porous metal body. According to the present invention, it is possible to remarkably reduce the content of impurity components in the resulting porous metal body by maintaining the raw metal under a reduced pressure within a certain temperature range to thereby degas the metal (see, page 27, lines 13-18 in the specification, in particular).

If the pressure reduction is insufficient, the remaining impurity components may impair the corrosion resistant, chemical resistance, toughness and so forth of the porous metal body (see, page 10, lines 4-07 in the specification, in particular).

To confirm this effect, we enclose a Declaration by Dr. Hideo Nakajima, the inventor, which details experiments wherein the raw material was treated with and without a degassing step prior to introducing a nitrogen containing gas. The result of the example in the appended declaration confirms the effects of the present invention mentioned above, that is, by degassing

the raw metal material after melting the metal, the corrosion resistance of a porous metal is improved.

Further, by using nitrogen as the pressurizing gas component, a nitriding phase is formed on all surfaces including the internal surfaces of the pores, resulting in a marked increase in hardness (see page 27, lines 19-23 in the specification, in particular).

Aditionally, the porous metal material obtained according to the present invention is lightweight, has high specific strength (strength/weight), and has excellent machinability, weldability and so forth (see page 27, line 24 to page 28, line 2) in the specification, in particular).

In order to achieve the above excellent advantages, it is important to follow the following points (i) and (ii):

(i): maintaining the raw metal material under a reduced pressure in the range of 10^{-1} and 10^{-6} Torr within a temperature range which is 50 to 200°C lower than the melting point of the metal to thereby degas the metal;

(ii): melting the raw metal material and introducing a gas containing nitrogen to thereby dissolve the gas in the molten metal.

(B) Claims 1, 2, 8, 12, 14 and 17

The Examiner has rejected Claims 1, 2, 8, 12, 14 and 17 under 35 USC 103(a) as obvious, based on Shapovalov et al., in view of JP5-59462, and further in view of JP 3-17236. The rule according to MPEP 2143 is that to establish a *prima facie* case of obviousness: (1) there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings; (2) there must be a reasonable expectation of success; and (3) the prior art reference (or references when combined) must teach or suggest all the claim limitations.

(B-1) As admitted by the Examiner, Shapovalov fails to disclose the following two points;

(i′) Step of maintaining the raw metal material under a reduced pressure at a preheating temperature just below the melting pot of the metal, and

(ii′) Use of nitrogen gas and, optionally, one or more gases as pressurization gas.

(B-2) In order to fill gap (i′), the Examiner cites JP 5-59462 and asserts that it would have been obvious to modify the method for manufacturing porous metallic articles by adding a step taught by JP 5-59462.

However, JP5-59462 is directed to a method for producing high purity copper suitable for use in high vacuum equipment. JP 5-59462 provides high purity copper emitting a reduced amount of gasses and suitable for use in high vacuum equipment (see paragraph [0006]). There is nothing in JP 5-59462 to a method for producing a porous metal.

What is more, JP 5-59462 states in paragraph [0012] that "it is preferable not to heat the rated copper at a temperature of 200°C or higher after the heat-treatment for degassing". In contrast, for producing the porous metal of the present invention, it is necessary to heat and melt the metal to dissolve gas/gases therein.

Thus, a skilled person would not find it obvious to modify a method for porous metal by adding the degassing step of JP5-59462.

(B-3) In order to fill gap (ii′), the Examiner cites JP 3-17236 and asserts that using hydrogen and nitrogen as the pressurization gas would be obvious.

However, the gas pore formation technique in JP 3-17236 is different from the present invention. The differences in gas pore formation between the technique of JP3-17236 and the present invention are schematically described in Table 1 (see attached).

The fabrication principles of JP3-17236 are as follows:

A gas such as hydrogen or nitrogen is dissolved into a molten metal and then, the chamber is rapidly depressurized <u>to form gas bubbles</u>. The melt is solidified as the <u>bubbles</u> are kept in the depressurized condition and a foamed metal can be produces. In principle, the technique utilizes Boyle's law, that is, $pV = p'V'$. When pressure is decreased from p to p', the bubble volume increases from V to V', where $p>p'$ and $V<V'$.

In contrast, the present invention is not concerned with the Boyle's law of gases, but utilizes <u>the gas solubility gap between solid and liquid phases</u>. A nitrogen gas such as hydrogen-nitrogen mixture id dissolved into a molten metal and then the metal id solidified unidirectionally to form gas pores in the solid metal. When the metal is solidified, insoluble gas atoms evolve the gas pores in the solid metal, because the gas is less soluble in the solid than in the liquid. By using this technique, a porous metal with directional pores can be obtained.

JP 3-17236 states that a gas dissolved in the metal by a bubbling means. It also states that the gas component appears in the form of gas bubbles (see page 3, lines 3-10 in JP 3-17236, in particular). JP 3-17236 does not teach or suggest directional pores with controlled port diameter and shape.

In contrast, the present invention provides a method for producing a porous metal with directional pores, wherein the pore diameter and shape of the directional pores can be easily controlled. Thus, even a skilled person would not be taught a method for making a porous metal with directional pores by JP 3-17236 .

(B-4) Furthermore, the instant invention achieves unexpected results as described above by following points (i) and (ii). Nothing in the cited documents would make such results obvious.

(B-5) In view of the foregoing, the present invention is unobvious over Shapovalov, in view of JP 5-59462, and further in view of JP 3-17236.

(C) Claims 1, 2, 8 and 11-19

The Examiner has rejected Claims 1, 2, 8 and 11-19 under 35 USC 103(a) as obvious, based on Shapovalov, in view of JP5-59462, and further in view of Apfel (5,384,203).

(C-1) As described above in (B-2), JP 5-59462 fails to fill gap (i′) between the instant invention and Shapovalov.

(C-2) Further, Apfel fails to fill gap (ii′). Apfel teaches that placing a solid alloy material into a chamber containing an inert gas, such as argon or nitrogen, but not dissolving the gas into the metal. Apfel states that the use of an inert gas would be desirable to diminish oxidation rates (see, column 10, paragraph 3).

In contrast, in the present invention, a nitrogen-containing gas is used for a dissolving gas, and argon is desirable for controlling pore size and shapes. The gas is used for a different purpose in Apfel.

Further, to produce foams, Apfel injects a blowing liquid as a blowing material into the metal and breaks up the material into tiny droplets. Further, Apfel disperse the droplets throughout the melt (see Fig. 2 and column 7, lines 60-64; column 8, lines 56-60, in particular). The pore formation technique in Apfel is different from the present invention, and there is nothing in Apfel to teach or suggest a porous metal with directional pores.

Thus, a skilled person would not understand a method for porous metal with directional pores, even considering the technique of Apfel.

(C-3) Moreover, the instant invention achieves unexpected results as described above by following points (i) and (ii). Noting in the cited documents would make such results obvious.

(C-4) In view of the foregoing, the claimed invention is not obvious over Shapovalov, in view of JP 5-59462, and further in view of Apfel.

(D) <u>Claims 1, 2, 8 and 11-19</u>

The Examiner has rejected Claims 1, 2, 8 and 11-19 under 35 USC 103(a) as obvious, based on Shapovalov, in view of JP 5-59462, and further in view of JP 10-158761.

(D-1) As described in (B-2), JP 5-59462 fails to fill gap (i′).

(D-2) Further, JP 10-158761 fails to fill gap (ii′).

JP 10-158761 states that, it is necessary that the gas dissolved in the molten metal undergoes a eutectic reaction when the molten metal is solidified (see paragraph [0017] and Fig. 2, in particular). Further, JP 10-158761 states that in the case where a gas that forms a solidified composition by other than a eutectic reaction is used, it is difficult to form pores during the solidification (see paragraph [0020] in particular).

In contrast, in this invention, a porous metal body can be produced at not only a eutectic point but also other points, and thus it is possible to produce a porous metal material with a controlled pores shape, size, porosity, and so on controlled by an easy method (see, for example, Fig. 2 in the present specification).

Thus, gas pore formation technique of JP 10-158761 is substantially different from the present invention, and a skilled person would not achieve the present invention, even considering the technique of JP 10-158761.

(D-3) What is more, the present invention achieves unexpected results as described above by following points (i) and (ii). Such results would not be expected from the cited references.

(D-4) In view of the foregoing, we believe that the present invention is not obvious over Shapovalov, in view of JP 5-59462, and further in view of JP 10-158761.

(E) <u>Claim 10</u>

The Examiner has rejected Claim 10 under 35 USC 103(a) in view of Shapovalov, JP 5-59462 and JP 3-17236 (as for Claim 1) in further view of JP3-294437. As described above,

Claim 1, on which Claim 10 is dependent, should not be considered obvious over the cited references. The Examiner cites JP3-294437 as teaching a method of continuous casting. However, JP3-294437 does not teach how to modify the teachings of Shapovalov, JP 5-59462 and JP 3-17236 to include the features of Claim 1 as discussed above (2). Therefore, Claim 10 is not obvious in view of the cited references.

(F) Claim 20

The Examiner has rejected Claim 20 under 35 USC 103(a) as being unpatentable in view of Shapovalov (US 5,181,549), JP 5-59462 and Apfel (US 5,384,203) or JP 10-158761 (as for Claim 15) in further view of JP3-294437. As described above (see (3) and (4)), Claim 15, on which Claim 20 is dependent, should not be considered obvious over the cited references. As stated by the Examiner, JP3-294437 teaches a method of continuous casting. However, JP3-294437 does not teach how to modify the combined method to include the features of Claim 15. Therefore, Claim 20 cannot be considered obvious.

IV. Other Points

The Examiner states that the declaration under 37 CFR 1.132 filed July 14, 2005 is insufficient to overcome the rejection of Claims 1,2, 8 and 10-20 as set forth in the prior Office Action because "the criticality of the nitrogen gas used alone has not been set forth" (see page 10 in the Office Action).

However, the case of using nitrogen gas alone was demonstrated in the declaration filed November 16, 2004. From the results shown in the declaration, it is clear that the strength of the obtained material can be increased by using a nitrogen single gas (see case (f) and Fig. 29 in the declaration).

CONCLUSION

In view of the above, it is submitted that the claims are in condition for allowance. Reconsideration and withdrawal of all outstanding rejections are respectfully requested. Allowance of the claims at an early date is solicited. If any points remain that can be resolved by telephone, the Examiner is invited to contact the undersigned at the below-given telephone number.

Please charge the fee for the required one-month extension, and any other required fees, including any fees for additional extensions of time, to our Deposit Account No. 11-1410.

Respectfully submitted,

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